The VDA Specification for car hands-free: A step towards improved speech quality in car type environments.

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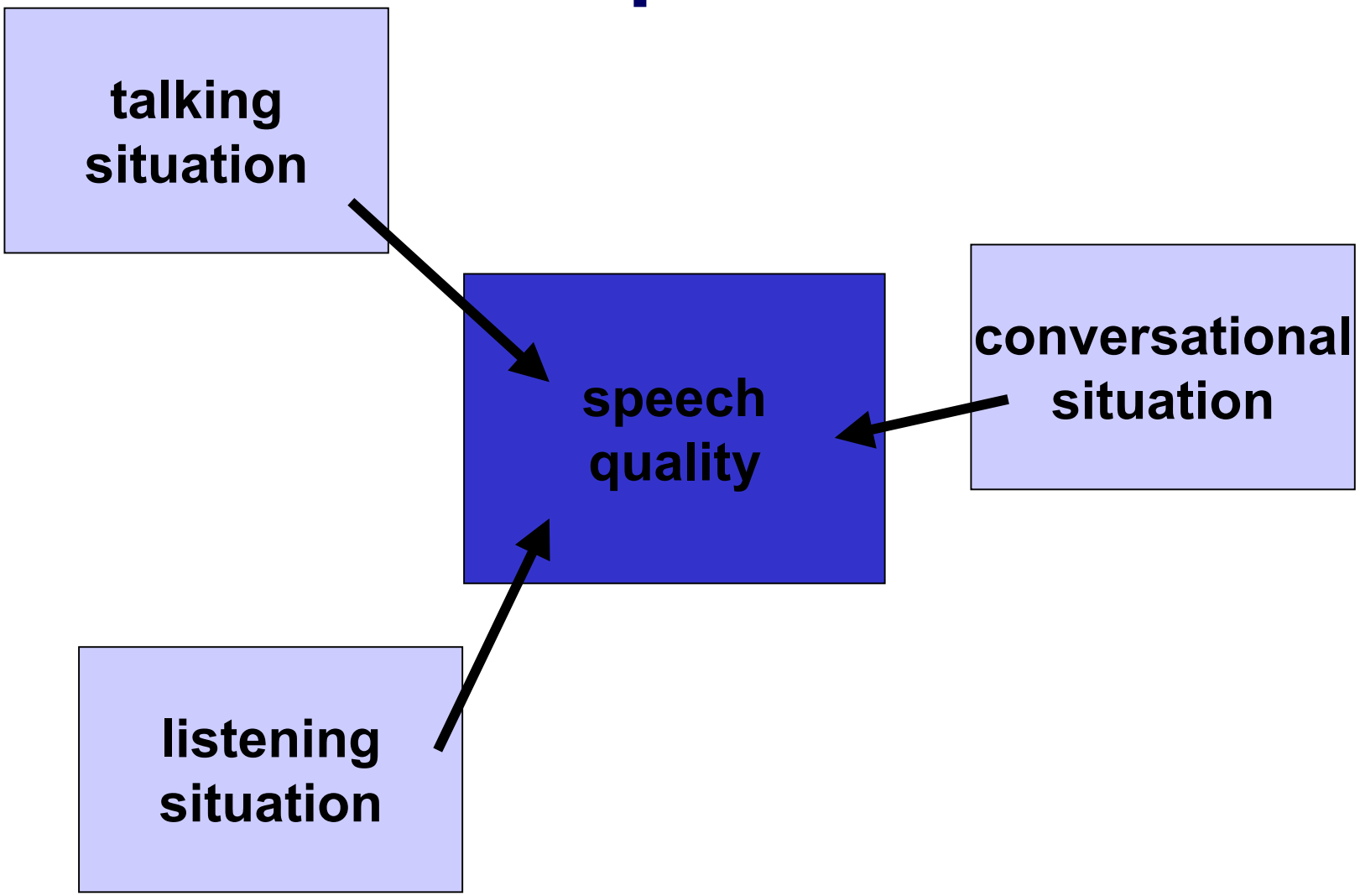
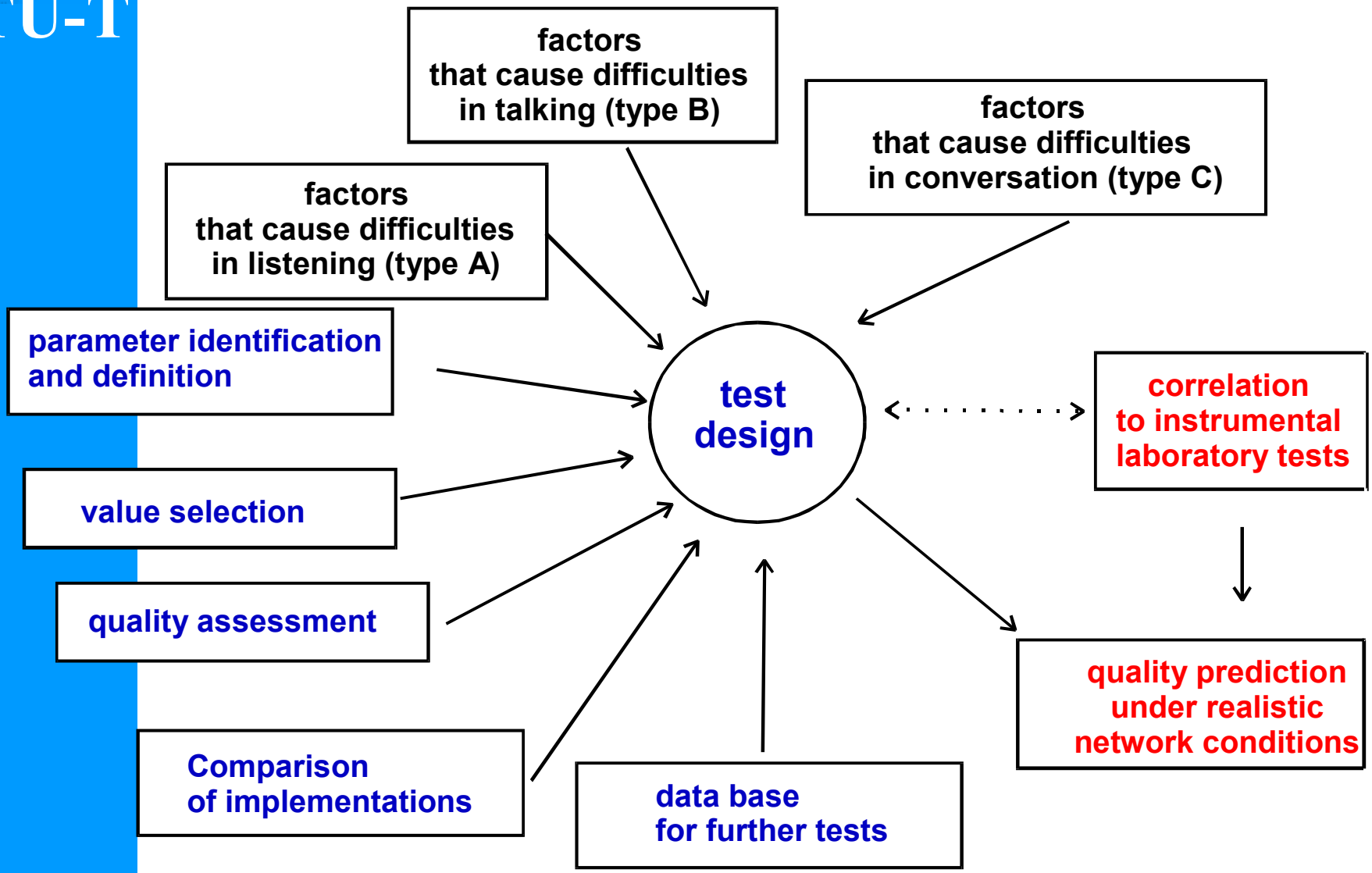
Outline

- Speech Quality: The Relevant Parameters
- Signal Processing in Car Hands-Free Systems
- The VDA Approach:
  - Test Setup
  - Tests
  - Test Signals
- Requirements for further Work and Standardization

Speech Quality from the Users Perspective



Choice and Design of Subjective Tests Methods

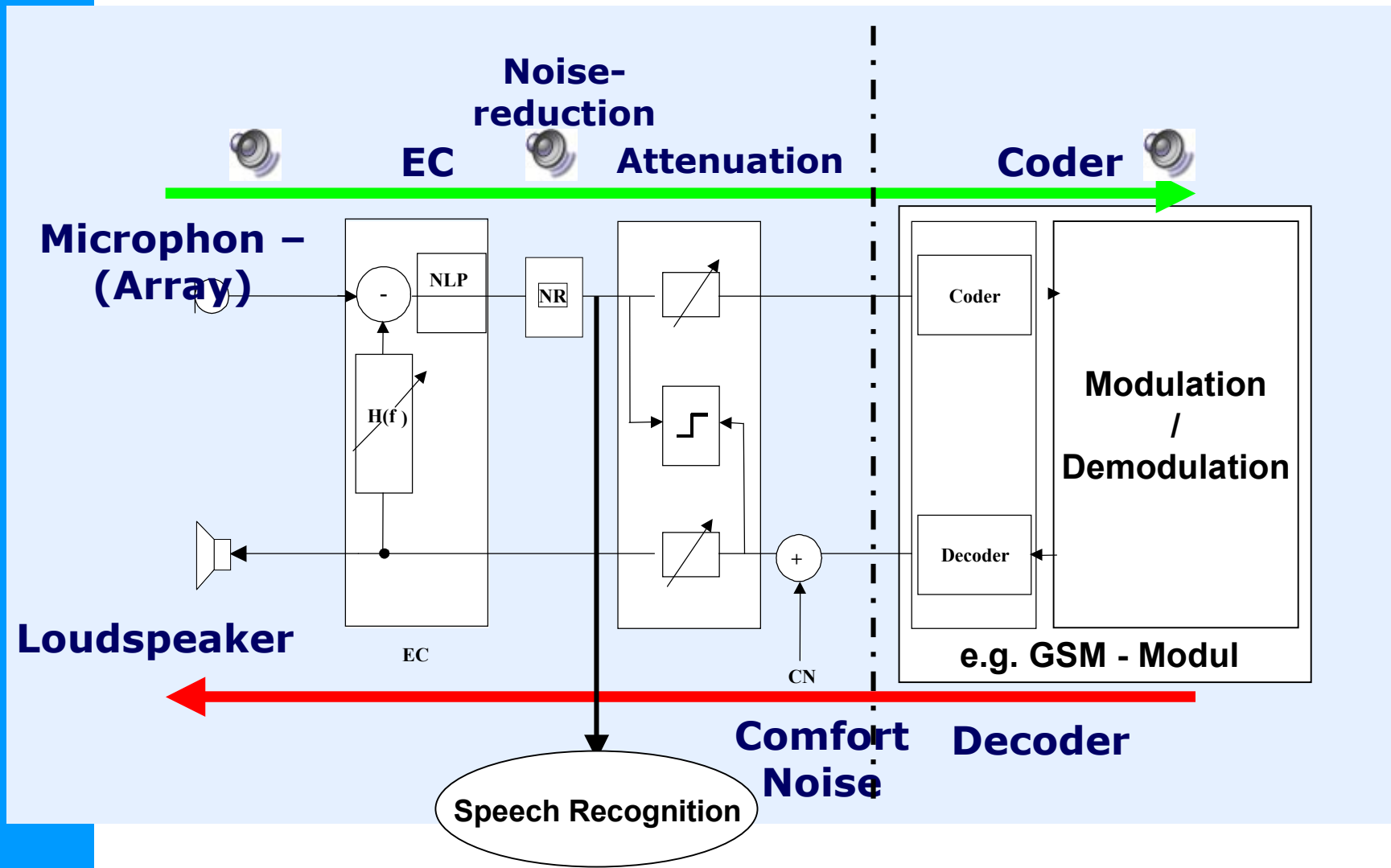


Parameters Relevant to Quality

- Auditory perceived parameters which determine the speech quality of hands-free terminals:

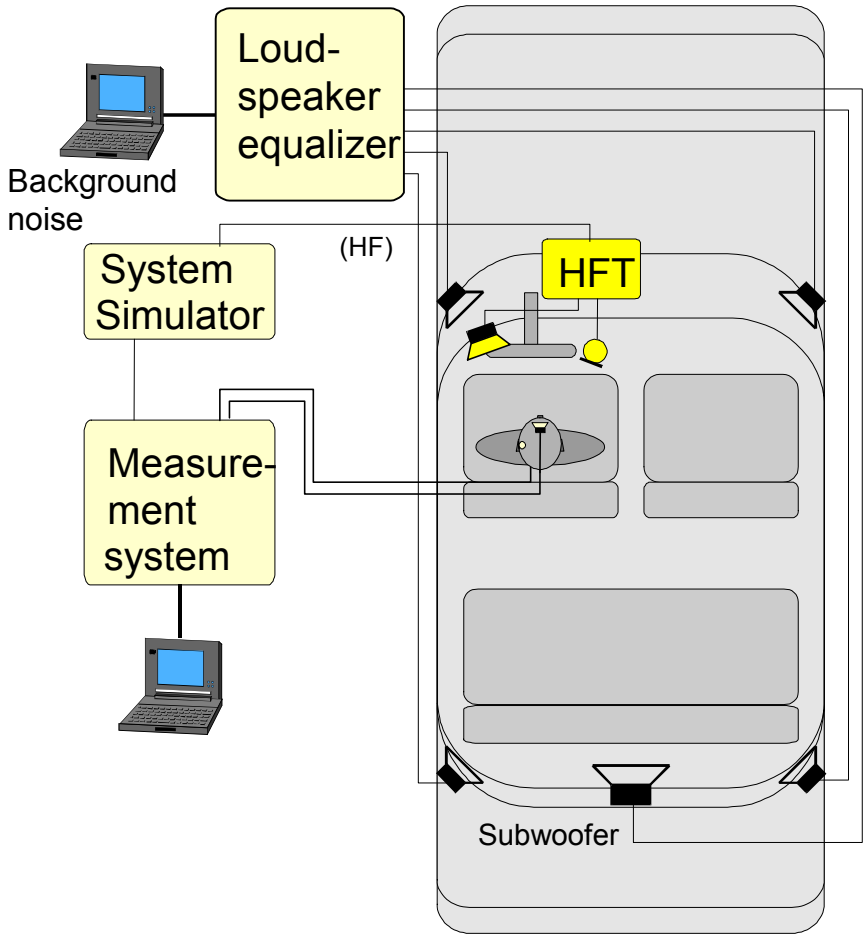
  - **Quality of background noise transmission**
  - **(Speech) sound quality**
  - **Delay and echo**
  - **Double talk capability**
  - **Switching and echo during double talk**
  - **Loudness**
  - **(System) noise**

Hands-Free Signal Processing



VDA: The Test Setup

- real car cabin
- installed hands-free terminal
- System simulator (GSM, ...)
- Background noise simulation
- HATS **H**ead **a**nd **T**orso **S**imulator (ITU-T P.58, P.581)
- VDA Specification or HQS-HFT



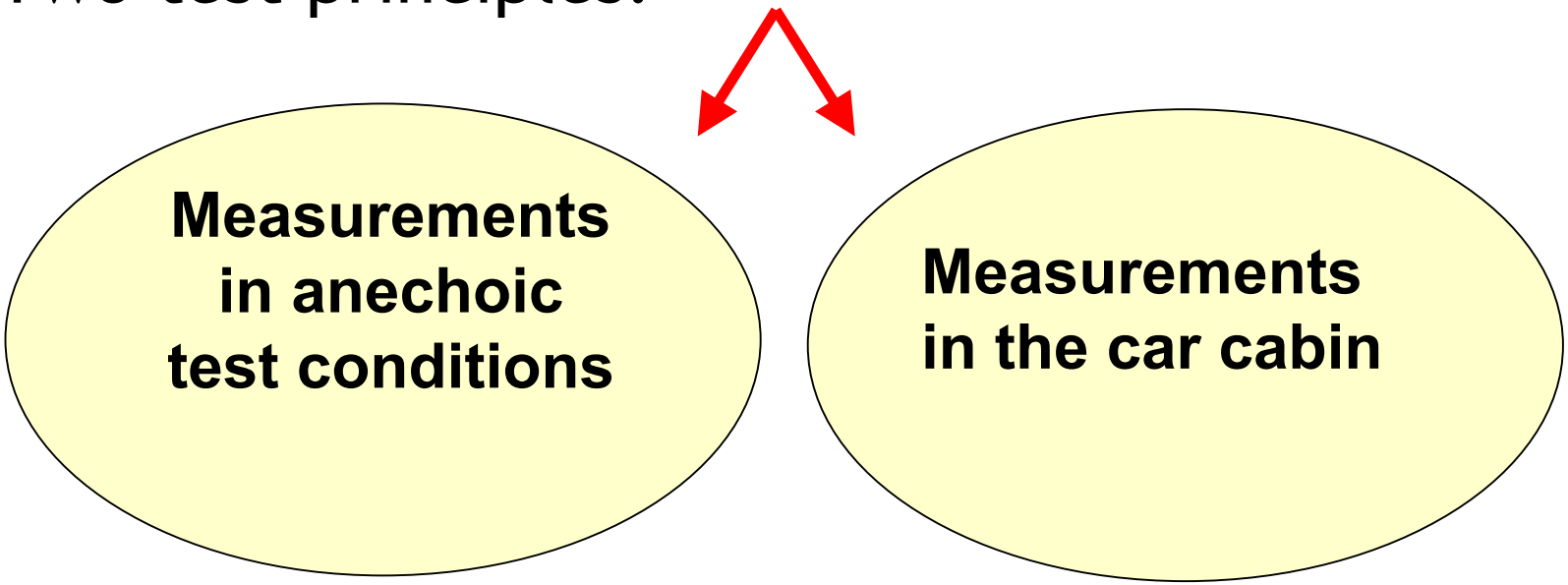
The Structure of the VDA Specification

- Microphone measurements:
  - **Sensitivity, frequency responses, ambient noise reduction…**
- Hands-free measurements:
  - **Delay**
  - **Standard parameters (LR, responses, noise, out of band …)**
  - **Echo related parameters (TCL, vs. time, spectral…)**
  - **Switching characteristics**
  - **Double talk parameters (attenuation, echo)**
  - **Background noise transmission parameters**

Microphone Measurements

ITU-T

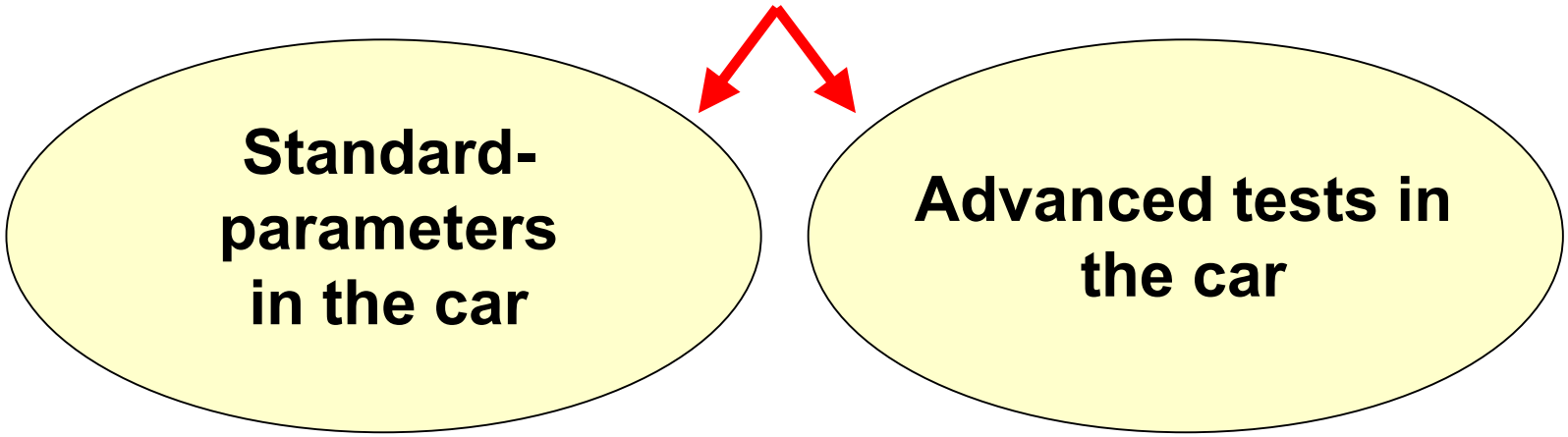
Two test principles:



- sensitivity
- linearity
- distortions

- Sensitivity
- linearity
- distortions
- frequency response
- idle noise
- ambient noise reduction

Hands-free tests

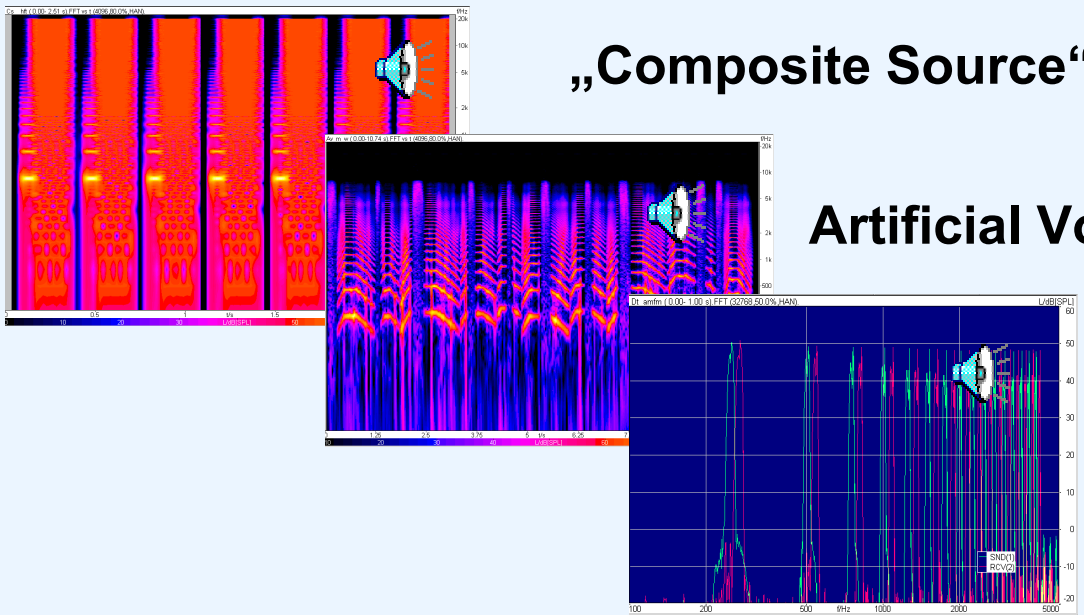


- Frequency Response
- Loudness Ratings
- Distortions
- Noise
- Out of Band signals
- Terminal Coupling Loss

- Delay
- Background Noise suppression (DeLSM
- Distortions
- Echo loss - time variant, spectral
- Double talk performance
- Background noise performance
- Comfort noise insertion

Testsignals:

Speech-like, but adapted to the specific measuerement task:



„Composite Source“ Signals

Artificial Voice

Modulated Voiced Sound

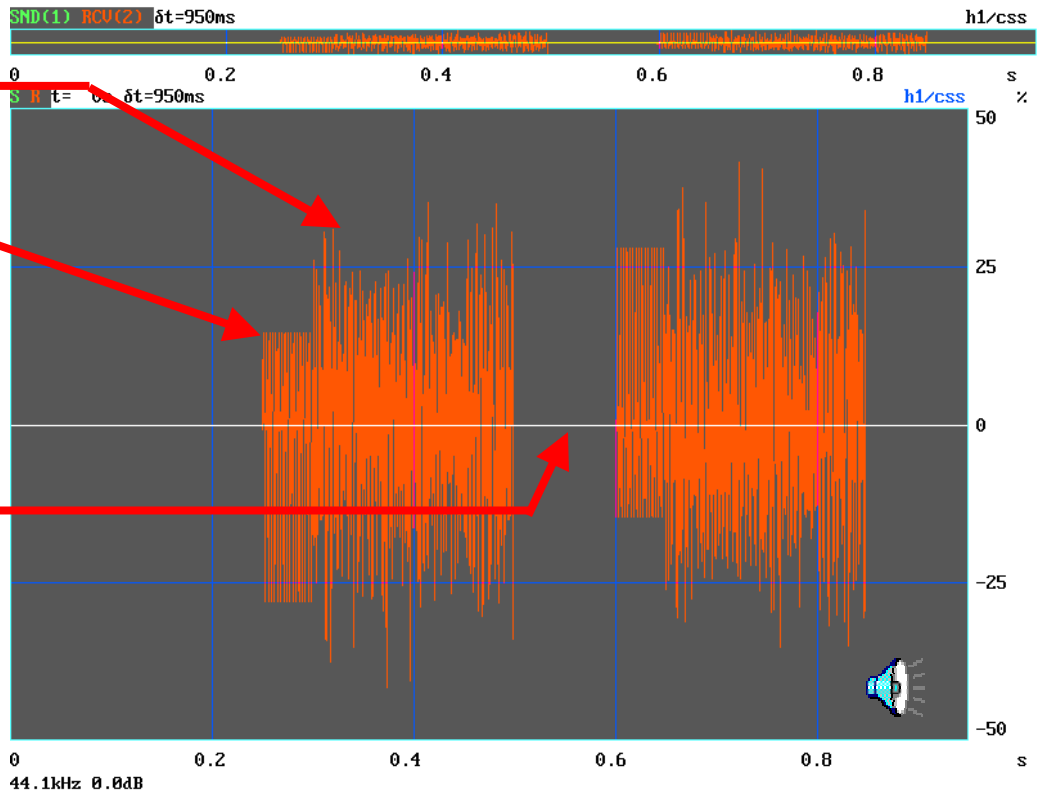
Testsignals (CSS)

Composite source Signals

Pseudo Noise

Voiced Sound

Pause



Signal description in ITU-T P.501

(Noise)- Measurement with Activation Test Signal

Test signal

activation CSS

-28.7 dB_{Pa}

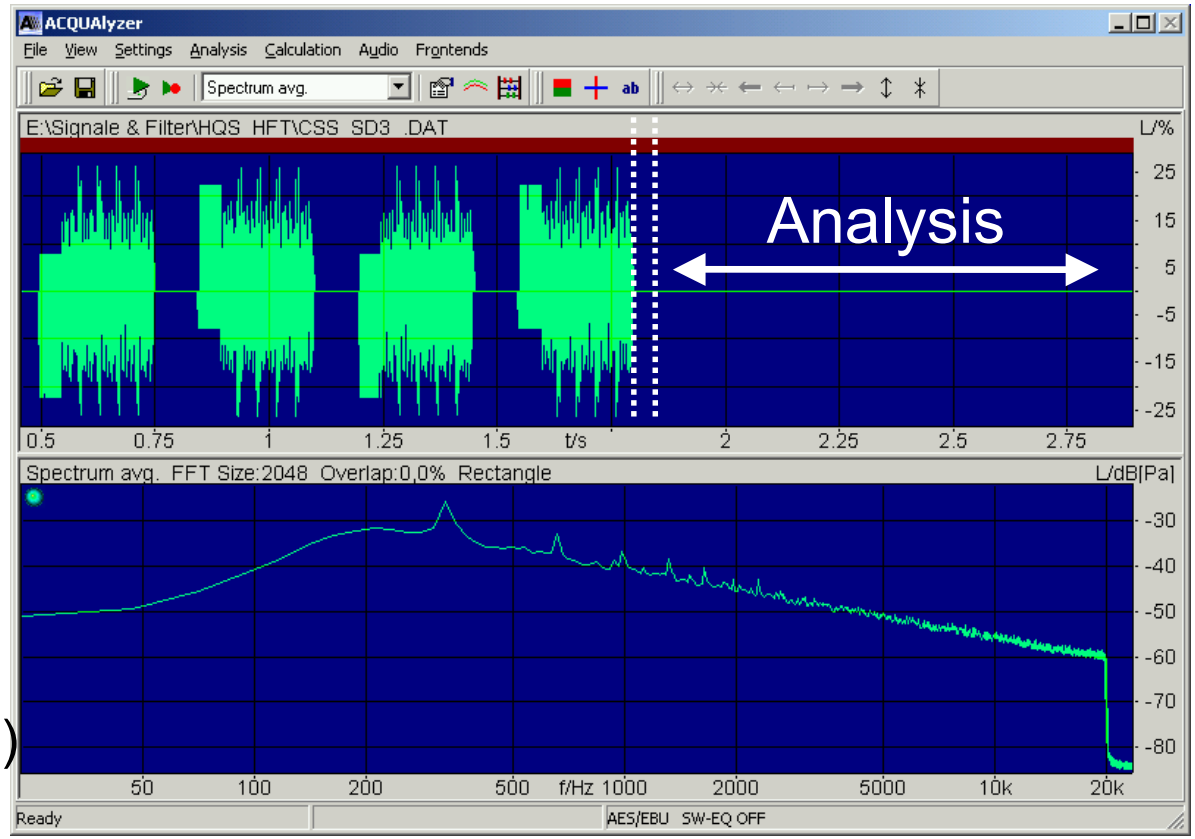
Test / Analysis

after activation

window length 1s (smaller if necessary!)

Requirements

GSM < -64 $dB_{m0}(P)$ *(3GPP)*



Terminal Coupling Loss

Test signal

Activation artificial voice, -16 dB_{m0}

pseudo noise sequence -3 dB_{m0}

Test / Analysis

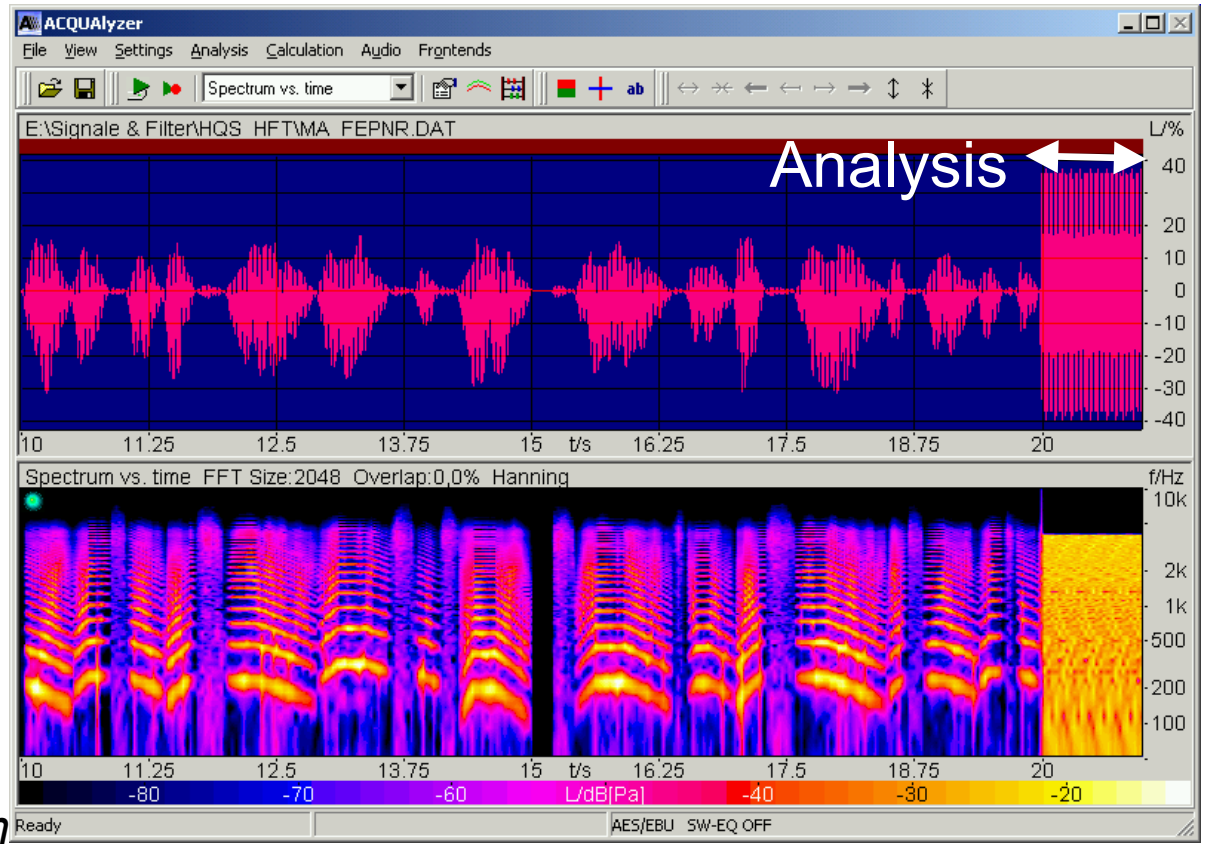
Terminal coupling loss according to G.122

Requirements

> 40 dB *(3GPP)*

> 46 dB recommended *(ITU)*

> 33 dB at maximum volume



Double Talk Performance

Test signal

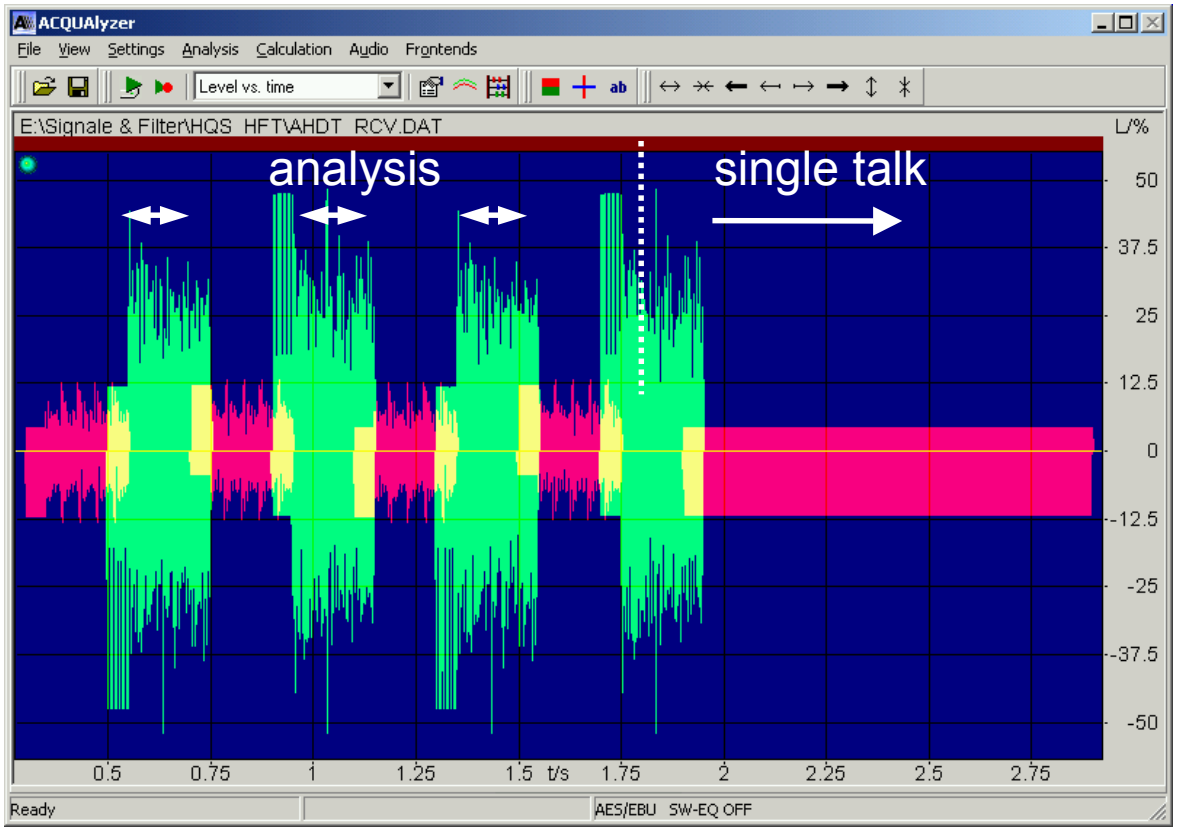
Combination of CS signals

Test / Analysis

Level vs. time

Requirements

Type of classification!



Classification based on ITU-T Rec. P.340

	Type 1	Type 2	Type 3
Subjectively Relevant Parameter	Full duplex capability	Partial duplex capability (in P.340 and VDA more precise)	No duplex capability
Objective Parameter • $a_{H,SND,DT}$ • $a_{H,RCV,DT}$ • **Echo attenuation**	< 3 dB < 3 dB ≥ 37 dB	12 - 3 dB 10 - 3 dB 36 - 21 dB	> 12 dB > 10 dB < 21 dB

Summary

- Speech quality has to consider the conversational situation - the listening situation, the talking situation and double talk
- Objective parameters are combined by standard parameters as well as specific parameters determining double talk and background noise transmission quality
- Specific test signals are suited for the detailed evaluation of the various parameters

To Do:
Requirements for Future Work

- Speech quality in the presence of background noise
- Quality of the noise transmission
- Dynamic background noise simulation
- Speech quality in combination with varying network quality
- Requirements for wideband conversational speech quality